# (19) World Intellectual Property Organization

International Bureau





### (43) International Publication Date 5 August 2004 (05.08.2004)

PCT

## (10) International Publication Number WO 2004/066389 A3

(51) International Patent Classification7: H01L 27/115. 21/8247, 21/336

(21) International Application Number:

PCT/IB2003/006184

(22) International Filing Date:

16 December 2003 (16.12.2003)

(25) Filing Language:

**English** 

(26) Publication Language:

English

(30) Priority Data: 03100124.1

22 January 2003 (22.01.2003)

(71) Applicant (for all designated States except US): KONIN-KLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventors; and

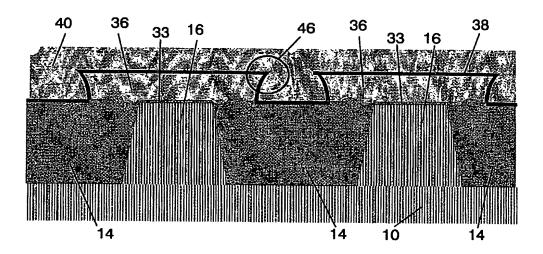
(75) Inventors/Applicants (for US only): VAN SCHAIJK,

Robertus, T., F. [NL/NL]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). SLOTBOOM, Michiel [NL/NL]; c/o Prof . Holstlaan 6, NL-5656 AA Eindhoven (NL).

- (74) Agent: DULJVESTIJN, Adrianus, J.; Philips Intellectual Property & Standards, Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: FLOATING GATE ISOLATION AND METHOD OF MAKING



(57) Abstract: The present invention relates to a method for forming a set of floating gates which are isolated from each other by means of slits, as well as semiconductor devices using the floating gate. The present invention provides a method for manufacturing an array of semiconductor devices on a substrate (10), each device having a floating gate (36), comprising: first forming isolation zones (14) in the substrate (10), thereafter forming a floating gate separator (32) on the isolation zones (14) at locations where separations between adjacent floating gates (36) are to be formed, after forming the floating gate separator (32), forming the floating gates (36) on the substrate (10) between parts of the floating gate separator (32), and thereafter removing the floating gate separator (32) so as to obtain slits in between neighboring floating gates (36). This method has an advantage over prior art in that less residues of floating gate material, or less floating gate material shorts between adjacent floating gates occur. Furthermore, the gate profile is damaged less than in prior art slit processing methods.

#### 

#### Declaration under Rule 4.17:

as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

#### Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- (88) Date of publication of the international search report: 14 October 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

## INTERNATIONAL SEARCH REPORT

Interponal Application No PCT/IB 03/06184

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H01L27/115 H01L21/8247 H01L21/336

According to International Patent Classification (IPC) or to both national classification and IPC

#### **B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols) IPC 7 - H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**EPO-Internal** 

C. DOCUME	ENTS CONSIDERED TO BE RELEVANT					
Category °	Citation of document, with indication, where appropriate, of the relevant passa	ages Relevant to claim No.				
X	US 6 261 905 B1 (CHEN JONG ET AL) 17 July 2001 (2001-07-17) column 4, line 42 - column 8, line 18; claim 9; figures 1-4	1,9,11				
X	US 6 060 358 A (BRACCHITTA JOHN A ET AL) 9 May 2000 (2000-05-09) column 6, line 27 - column 8, line 8; figures 3-18					
X	US 6 146 970 A (CHEN MIKE HSIAO-HUI ET AL) 14 November 2000 (2000-11-14) column 6, line 1 - column 9, line 40; figures 6-14	1-9,11				
<u> </u>		atent family members are listed in annex.				
"A" docume consid "E" earlier of filling d "L" docume which citation "O" docume other of the citation of the citation in the citation of the c	tered to be of particular relevance  document but published on or after the International late ant which may throw doubts on priority claim(s) or is cited to establish the publication date of another or other special reason (as specified) ent referring to an oral disclosure, use, exhibition or means ent published prior to the International filing date but nam the priority date claimed  cited to determine the inventorial country and documents.	tent of particular relevance; the claimed invention of be considered novel or cannot be considered to ve an inventive step when the document is taken alone tent of particular relevance; the claimed invention of be considered to involve an inventive step when the ment is combined with one or more other such docuses, such combination being obvious to a person skilled				

09/08/2004

Neumann, A

Authorized officer

30 July 2004

European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo ni, Fax: (+31-70) 340-3018

Name and mailing address of the ISA

# INTERNATIONAL SEARCH REPORT

Interponal Application No
PCT/IB 03/06184

		PCT/IB 03/06184
	ation) DOCUMENTS CONSIDERED TO BE RELEVANT	
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Х	US 5 643 813 A (HSU LOUIS LU-CHEN ET AL) 1 July 1997 (1997-07-01) column 5, line 1 - column 7, line 10; figures 1-14	1,9-14
X	US 6 365 459 B1 (LEU LEN-YI) 2 April 2002 (2002-04-02) column 4, line 23 - column 6, line 25; figures 1-3	12-14
X	US 5 488 244 A (WEI CHE C ET AL) 30 January 1996 (1996-01-30) column 3, line 23 - column 6, line 7; figures 1-9	12-14
	,	

# INTERNATIONAL SEARCH REPORT

Interional Application No
PCT/IB 03/06184

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 6261905	B1	17-07-2001	NONE		
US 6060358	Α	09-05-2000	NONE		
US 6146970	Α	14-11-2000	NONE		
US 5643813	A	01-07-1997	US EP JP JP KR US	5622881 A 0706222 A1 3056983 B2 8115988 A 217532 B1 5892257 A	22-04-1997 10-04-1996 26-06-2000 07-05-1996 01-09-1999 06-04-1999
US 6365459	B1	02-04-2002	US	6114723 A	05-09-2000
US 5488244	Α	30-01-1996	NONE		